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CUSTOMERS FIRST

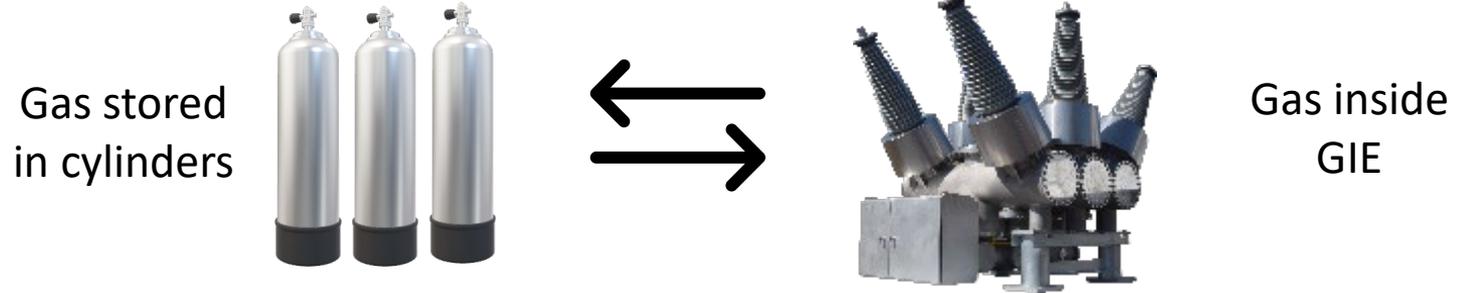
# Feedback on Implementing the Nameplate Adjustment Procedure on Gas-Insulated Circuit Breakers

2023 Workshop on SF6 Emission Reductions and Alternatives

July 25-26, 2023

# Why is the Nameplate Adjustment Procedure necessary?

- **Emission calculation** is a mass-balance between insulating gas stored in gas cylinders and gas added to or removed from gas-insulated equipment (GIE) such as circuit breakers and switches during the year.



- **“Nameplate gas capacity”** is used in the emission calculation to represent the amount of insulating gas inside the GIE.
  - Ideally the Nameplate Gas Capacity and the amount of insulating gas transferred between gas cylinders and GIE are the same, so the emission calculation equation will balance.
  - Emissions result when gas recovered from GIE < nameplate gas capacity.
  - An incorrect Nameplate Gas Capacity value will skew the calculated emissions.

# Why is the Nameplate Adjustment Procedure necessary?

- **Discrepancies exist** between the Nameplate Gas Capacity on the GIE data plate, and the actual gas fill based on manufacturer specified operating pressure.
  - LADWP has observed discrepancies ranging from 3 to 350 pounds per GIE.
- **Improve accuracy** of emission calculation and eliminate “phantom emissions” or surplus gas due to incorrect Nameplate Gas Capacity value.
  - Phantom emissions can cause exceedance of the annual emissions limit (1% in California).



# Nameplate Discrepancy Examples

## Commissioning

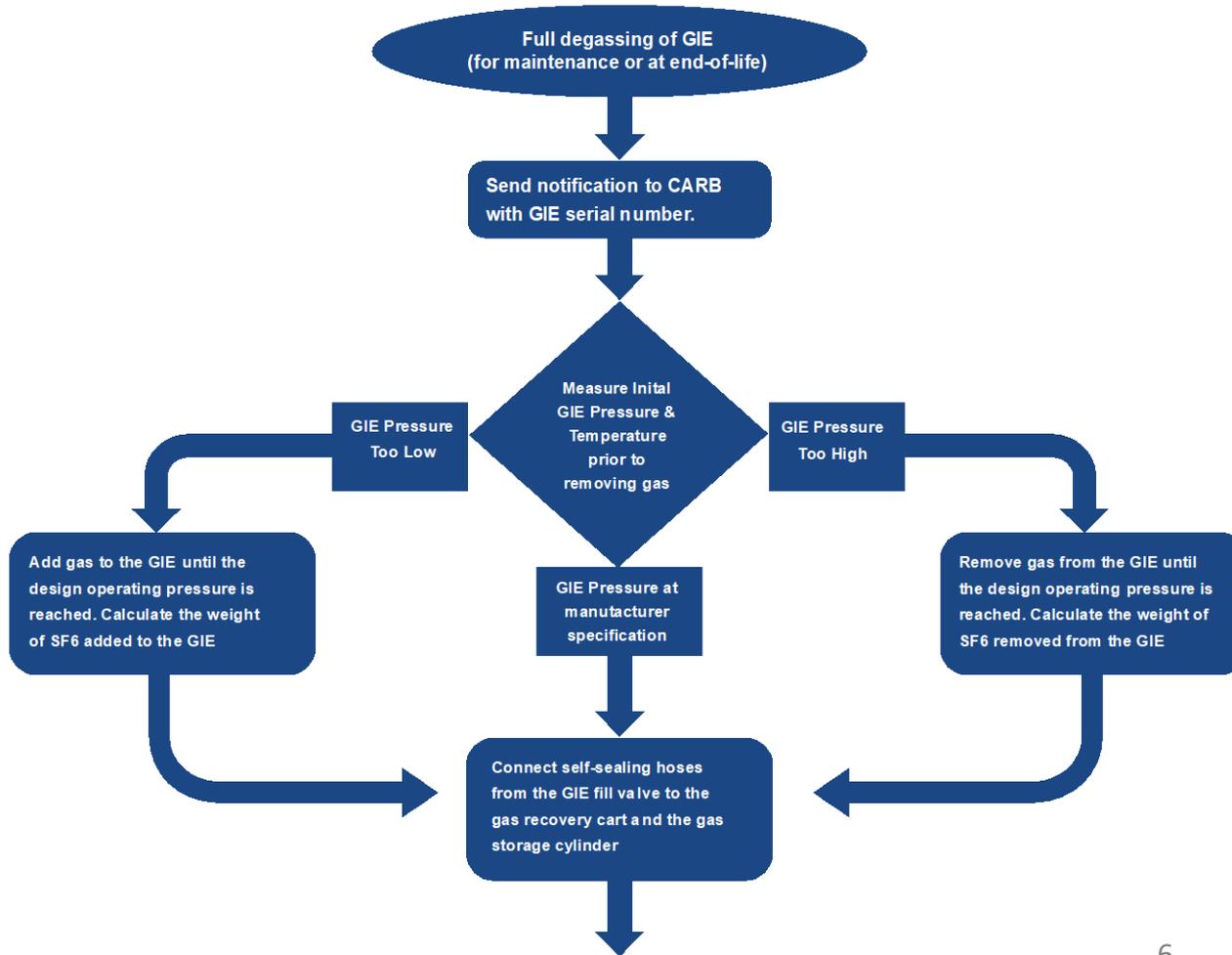
GIE Type	Nameplate Gas Capacity (pounds)	Actual Gas Capacity (pounds)	Difference in pounds (%)
550 kV DTB (2018)	1817 (revised to 1455)	1470	347 (19%)
550 kV DTB (2020)	1464 (revised to match fill)	1550	86 (6%)
550 kV DTB (2020)	1785	1854	69 (4%)
245 kV DTB (2011)	270 (revised to 229)	219	51 (19%)
38 kV DTB (2010-19)	26 (revised to 28.5)	29	3 (11%)

## Decommissioning

GIE Type	Nameplate Gas Capacity (pounds)	Actual Gas Capacity (pounds)	Difference in pounds (%)
550 kV DTB (1985)	2030	1990	40 (2%)
550 kV DTB (1994)	1680	1464	220 (13%)
245 kV DTB (2004)	310	244	66 (21%)
275 kV DTB (1994)	920	694	226 (25%)
550 kV DTB (1988)	1915	1637	278 (14%)

# What is the Nameplate Adjustment Procedure

- **Optional process to determine the actual gas capacity of gas-insulated equipment (GIE), by measuring amount of insulating gas recovered starting at “full and proper charge” and ending at blank off pressure.**
  - Full recovery of insulating gas from GIE at end-of-life (decommissioning) or before opening the gas compartment for maintenance.
- **Steps:**
  - **Verify GIE is at the manufacturer specified operating pressure prior to removing any insulating gas.**
    - If not, add or remove gas as needed until the manufacturer specified operating pressure is reached.
  - **Remove insulating gas until the blank off pressure is reached, then hold at least 5 minutes to ensure full recovery of the insulating gas.**
    - Tip: continue to apply vacuum to GIE until cylinder weigh scale displays no increase for at least 30 minutes to 1 hour.
  - **Weigh gas storage cylinders before and after recovering the insulating gas and calculate the total weight of gas recovered.**
    - This weight is the adjusted gas capacity value of the GIE.



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graph TD; A[Transfer gas per manufacturer instructions from the GIE into the gas storage cylinder until it reaches blank off pressure. After 5-minute hold at the blank off pressure, record the final system pressure, and record ending weight of the cylinder.] --> B[Record the adjusted GIE gas capacity, which is equal to the pounds of gas recovered from the GIE using this procedure.]; B --> C[Retain records and include adjusted GIE nameplate gas capacity information in annual report.]; C --> D[If GIE will be returned to service, create and affix label with date and adjusted gas capacity value next to original manufacturer data plate.];
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Transfer gas per manufacturer instructions from the GIE into the gas storage cylinder until it reaches the blank off pressure.

After 5-minute hold at the blank off pressure, record the final system pressure, and record ending weight of the cylinder.

Record the adjusted GIE gas capacity, which is equal to the pounds of gas recovered from the GIE using this procedure.

Retain records and include adjusted GIE nameplate gas capacity information in annual report.

If GIE will be returned to service, create and affix label with date and adjusted gas capacity value next to original manufacturer data plate.

# Implementing the Nameplate Adjustment Procedure

<u>Applicability</u>	<u>Exemptions</u>
<ul style="list-style-type: none"><li>• Opt-in</li><li>• Non-hermetic GIE &gt; 38 kV</li><li>• One-time adjustment per GIE, unless replace components (e.g. bushings) resulting in physical change to gas capacity.</li></ul>	<ul style="list-style-type: none"><li>• GIE <math>\leq</math> 38 kV</li><li>• Fully charged GIE to which owner does not add or remove gas</li><li>• GIE with compromised integrity (e.g. leaking or damage to gas containment vessel)</li><li>• GIE acquired after December 31, 2021<ul style="list-style-type: none"><li>– For GIE acquired after 12/31/2021, an accurate gas capacity value will be established at the time of initial fill.</li></ul></li></ul>

## Recordkeeping and Reporting

- Recordkeeping form for use in the field
- Use adjusted gas capacity value in the emissions calculation and equipment inventory portion of annual report.

# Challenges with Implementing Nameplate Adjustment Procedure

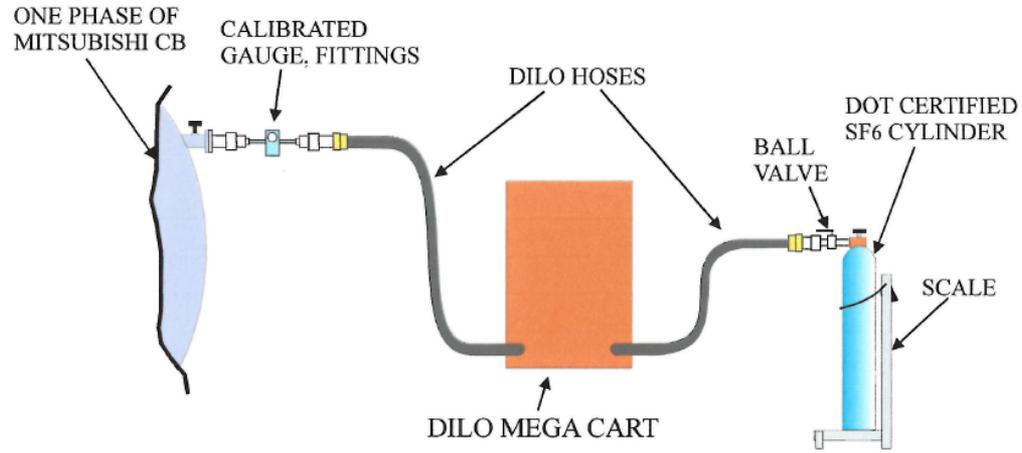
- **Communication**
  - Incorporating new procedure into existing work practices.
  - Notification in advance: communication between construction, maintenance, and environmental compliance staff.
- **Measuring pressure and temperature**
  - **Gauge accuracy requirements (CARB)**
    - Pressure gauge, accurate within 0.5% of the largest value the gauge can accurately record, according to the manufacturer's specifications.
    - Temperature gauges must be certified by the manufacturer to be accurate within +/-1.0° F.
- **Purchase new equipment if needed**
  - Highly accurate pressure and temperature gauges
  - Gas cart capable of extracting gas to blank off pressure



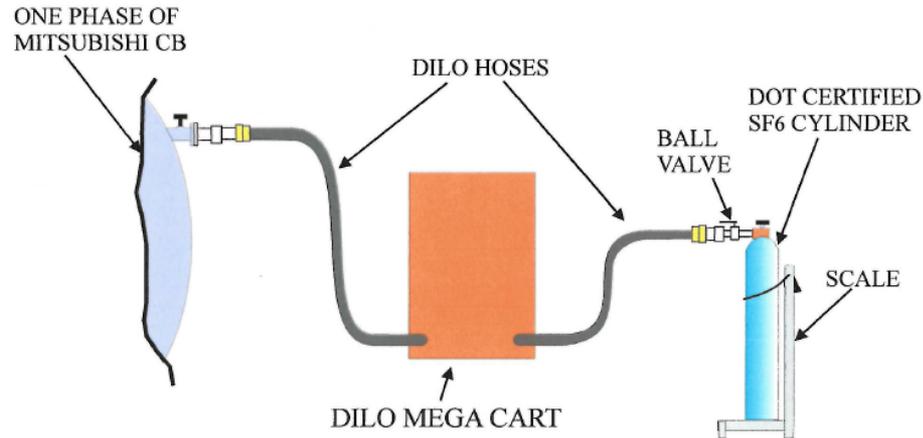
# Challenges with Implementing Nameplate Adjustment Procedure

- **Measuring pressure**
  - If the gauge is connected in-line with the gas recovery hose, the gauge fittings and hose are small, therefore slowing down the gas recovery rate.
    - If gauge is not connected in-line, how do you measure final system pressure at end of the gas recovery process?
  - Pressure gauge on the gas cart does not meet the gauge accuracy requirements.
  - External gauge may read a different value than the temperature-compensated gas pressure gauge attached to the GIE, that was used for the initial gas fill and to monitor and maintain the GIE at the proper operating pressure over its service life.
- **Measuring temperature**
  - Not feasible to measure temperature of gas inside the GIE without moving gas out of the GIE. Therefore cannot satisfy requirement to “Record the initial system pressure and vessel temperature **prior to** removing any insulating gas.”
  - The gas vessel for outdoor GIE will have a temperature gradient depending on direction the sun is hitting the gas vessel and how long it has been in the sun.
  - Attaching a temperature probe at the fill or pressure gauge port is not representative of the average internal gas temperature given the temperature gradient.

### BELOW: WITH CALIBRATED GAUGE



### BELOW: WITHOUT CALIBRATED GAUGE



# Questions?